REMARKS

Accompanying this response, please find replacement pages and marked-up pages of the specification which overcome some informalities noted in the specification on file. The undersigned avers that the enclosed replacement page(s) of the specification do not contain any new matter.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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Imaging

FIELD OF THE INVENTION

This invention relates to imaging and in particular to methods and systems for image enhancement.

BACKGROUND OF THE INVENTION

Imaging involves transfer from the object domain into the image domain, but owing to limiting factors such as the finite size of energy source, detector size, sampling frequency, display density, software filter function, and possibly partial-volume effects experienced with some imagers, an infinitely fine delta function in the object domain cannot be faithfully reproduced in the image domain. Instead, a smeared-out image, or point-spread function (PSF), is observed. Similarly, an infinitely sharp edge-response function (ERF) in the object domain becomes a smeared-out ERF in the image domain. The smearing effect becomes more intense as the adjacent ERFs of discontinuities or contrast profiles get closer to each other.

It is an object of the present invention to provide a method and system by which the above problem can be at least partly overcome.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a method wherein a de-convolution process is applied to the image-domain results of an object-scan to derive therefrom the respective point- or line-spread function effective in the object- to image-domain transfer of one or more object-discontinuities, and to derive from said function the location in the image domain of the respective discontinuity.

According to another aspect of the invention there is provided an imaging system comprising means for

performing a de-convolution process on the image-domain results of an object-scan to derive therefrom the respective point- or line-spread function effective in the object- to image-domain transfer of one or more object-discontinuities, and means to derive from said function the location in the image domain of the respective discontinuity.

The method and system of the invention enable the location of the respective discontinuity in the image domain, to be established with a high degree of accuracy. This is critical to image definition free of any substantial smearing, and to this end the location of the respective discontinuity may be derived to sub-pixel accuracy simply from the mid-point of the full-width half-maximum of said function.

The said function may be correlated with the image-domain results of said transfer for enhancement of spatial resolution of the imaging of the one or more discontinuities. This enhancement may involve transfer of sub-pixels within the image-domain results of the respective one or more discontinuities, the sub-pixels being transferred within their respective image-domain results from one side to the other of said location.

The de-convolution process may be carried out using least-squares running filtering.

BRIEF DESCRIPTION OF THE DRAWINGS

An imaging method and system according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates schematically the method and system of the invention;

Figure 2 illustrates features of processing performed in the method and system of Figure 1;

Figure 3 shows results achieved from use of the method and system of Figure 1;

Figure 4 shows to an enlarged scale a section of the contour of an image profile depicted in Figure 2;

Figures 5 and 6 are a plan view and sectional end-elevation of a couch-top used in the method and system of Figure 1; and

Figure 7 provides illustrates of a convolution operation, as a basis for a mathematical model of de-convolution processing in accordance with the method and system of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method and system to be described with reference to Figure 1 utilise MR scanning for medical diagnostic and treatment-planning purposes. In principle and in the general techniques described, the method and system of the invention can be used in other applications of MR scanning and also in circumstances where other scanning techniques are utilised. Furthermore, although both structure and function are represented by discrete 'boxes' 1 to 19 in Figure 1, the method and system are to a substantial extent manifest in programmed digital data-processing operations.

Referring to Figure 1, data derived in accordance with conventional operation of an MR scanner 1 is processed for imaging purposes within a processor 2. The output of the processor 2 is used to provide a display 3, and from this is subject to post-imaging processing 4. The post-imaging processing 4 includes the facility for selecting